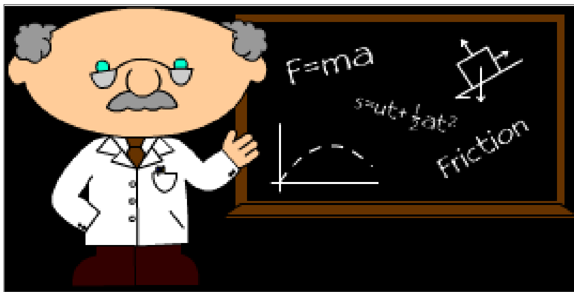
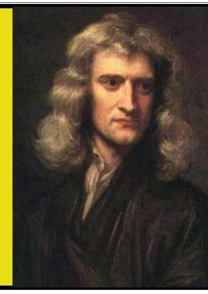


Unit 2: Dynamics



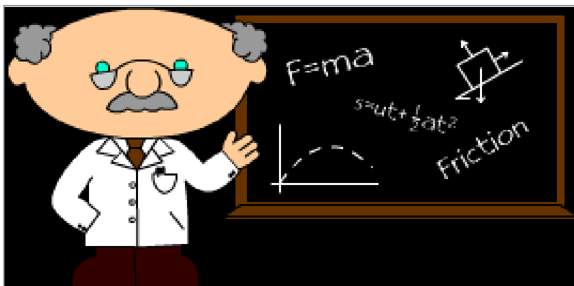
2.1 Forces and Newton's First Law

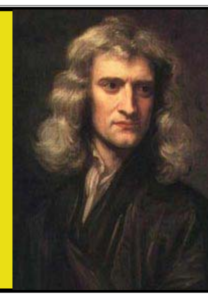
Dynamics = Forces

When we study HOW things move (how far, how fast), we are studying Kinematics.

The study of WHY things move is Dynamics.

So...WHY do objects move?





FORCES....that's why. We can group forces into four fundamental forces of nature:

Gravity

Electromagnetism

Weak Nuclear

Strong Nuclear

With these four forces, Physicists can describe most any phenomenon in the Universe. Forces are vector quantities.

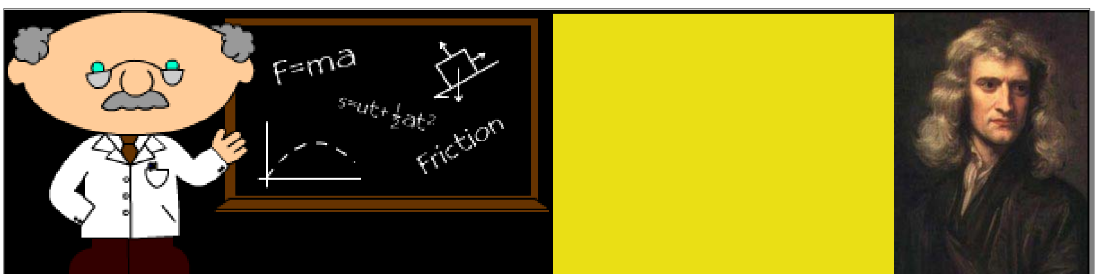
> an attractive force which governs the shape of the Universe

> exerted by all bodies on all bodies in the Universe

> depends on mass and seperation distance between bodies

> can act over very long distances

> acts through gravity fields



> attractive or repulsive forces that hold all matter together

> stems from the interaction of electrons in atoms

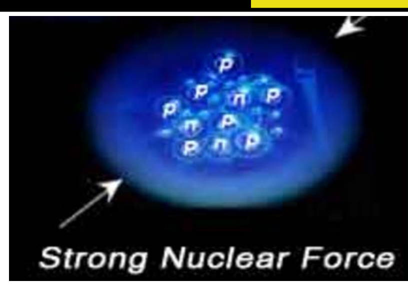
> magnetism and electricity are very closely related

> acts over short distances through electromagnetic fields

> a force that is responsible for decay in unstable radioactive atoms

> also acts through the field concept

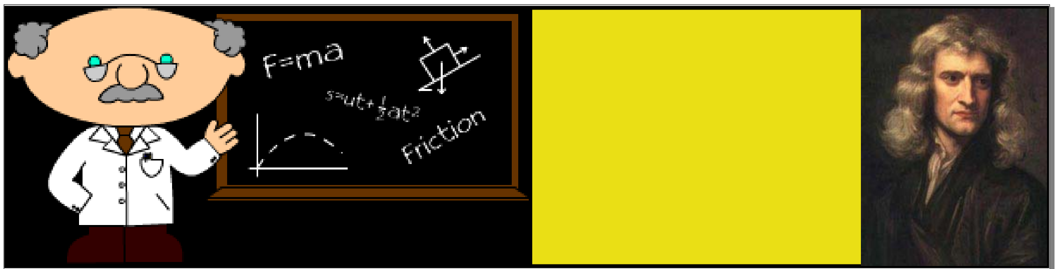
> approximately 10^{13} times weaker than strong nuclear force



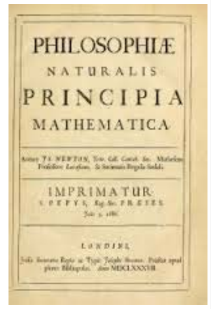
> in the nucleus of atoms, this is the force that binds positively charged protons together

> very strong but only acts over small distances (10^{-10} m(0.1 nanometre) or one Ångström)

> nuclear explosions (nuclear fission) is the result when the energy these bonds creates is released



<u>As We Learn More, Physics Ideas Change</u>


PHILOSOPHIÆ
NATURALIS
PRINCIPIA
MATHEMATICA
IMPRIMATUR

The things discussed here, were developed in the early 20th century up until the 1970's. They belong to the school of thought called "Standard Model of Physics."

The discovery of quarks and other sub-atomic particles has increased our understanding and some things have changed.

This "old stuff" can still be very useful to us.

For example, in 1687 at the age of 23, Sir Isaac Newton published the most important Math/Physics book of all time: the <u>Principia Mathematica</u>. It outlined three laws that govern all motion in the Universe.

Even though these ideas are over 300 years old, they still hold up as a good basis for studying Dynamics.

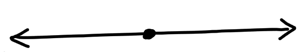
<u>Newton's First Law: The Law of Inertia</u>

"An object continues in a state of rest or in a state of motion at a constant speed along a straight path, unless acted on by a net force."

<u>Net Force</u>: the overall force, the sum of all forces acting on a body from all directions

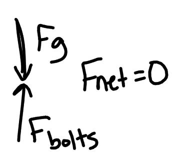
Ex.) Object at rest even though forces are acting on it: tug-of-war

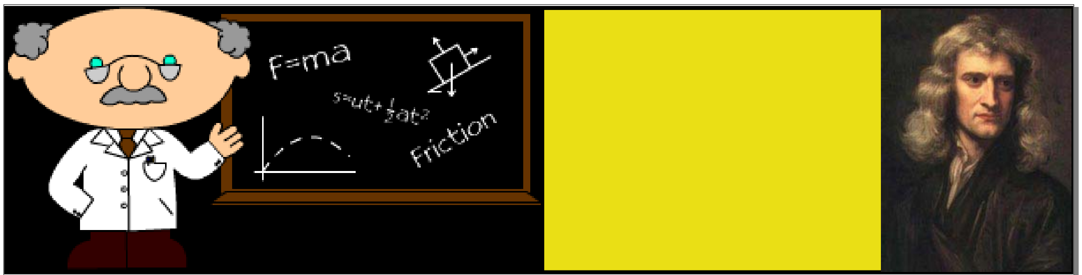
Draw a "force diagram/free body diagram".



Object @ rest
b/c $F_{net} = 0$

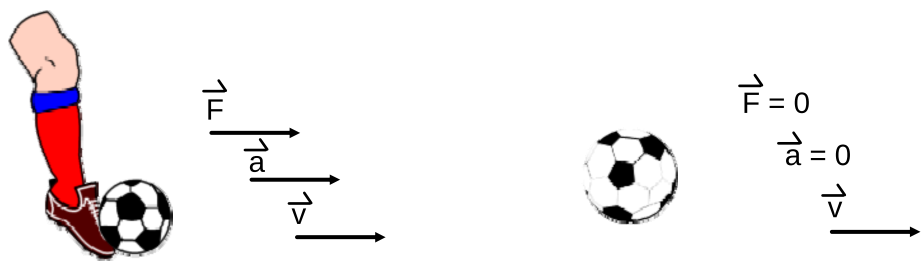
Ex.) A ceiling fan hanging from the ceiling. Will the fan fall?

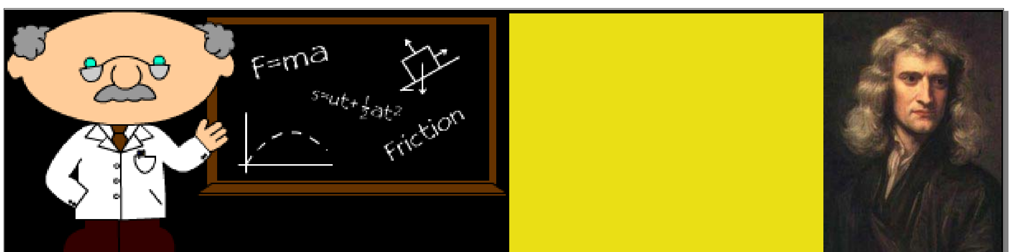




Ex.) Object continuing in a straight path with constant speed: soccer ball.

When kicked a force is applied to a soccer ball and the ball accelerates in the direction of the force with velocity in the direction of the force. Awhile later, no force is applied but the ball is still moving with a constant velocity in a straight line. No force is needed to keep the ball moving. It will only stop when a force is applied to it such as air resistance, friction, etc.





<u>Let's Get Some Things Straight:</u>

<u>Inertia</u> - the natural tendency of an object at rest to stay at rest and an object that is moving to stay moving

- inertia is related to mass; the more mass an object has, the more inertia

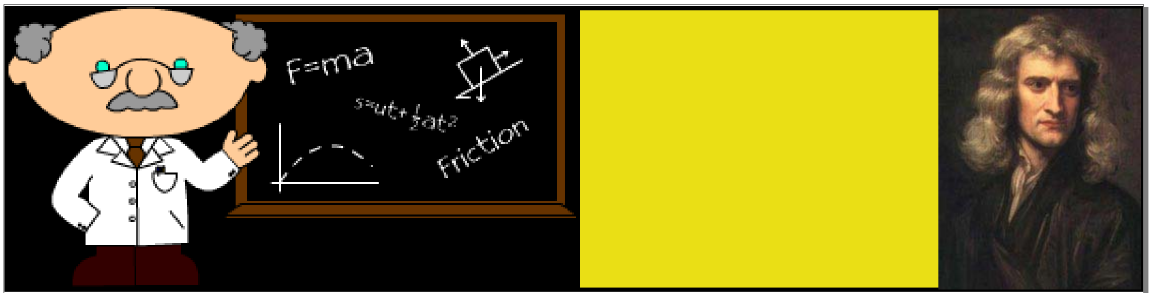
<u>Mass</u> - the amount of space an object takes up, not the same as weight (m = kg)

<u>Weight</u> - the amount of force due to gravity acting on an object, this is a force and varies planet to planet, your mass would be the same on every planet (w = kgm/s^2 = N)

Ex.) Inertia...the ol' table cloth trick

So if items at rest want to stay at rest then the dishes on the tables want to remain at rest unless acted on by a force. They move slightly meaning there was a small force of friction acting on them when the table cloth moved (small because the table cloth is smooth, shiny satin and he moves the table cloth very quickly.)

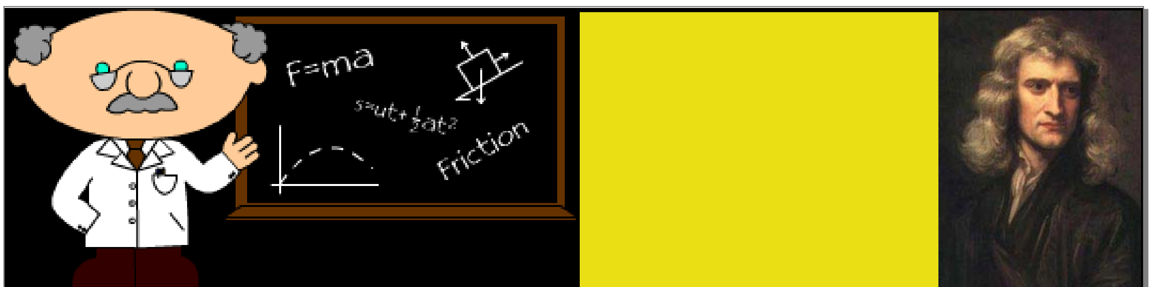
What would happen if the table cloth was moved slowly and made of rougher material?



Inertia Questions

1. Old cars were made of steel and barely dented when in an accident. Today, cars are made of material that easily crumples on impact. Why? What are the safety benefits of this change?

2. Silly Putty breaks when pulled apart quickly but stretches when pulled slowly. Use Newton's First Law to explain why.



Read: Pg. 126-142

Questions: Pg. 136 # 2-8.